

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims

1. (currently amended) A hardware configurable electronic controller for appliances comprising:

- a Non-Volatile Memory containing configuration data,
- a ~~configurable~~ Central Control Unit configurable in hardware to perform which performs the basic desired processing and control of the functioning of the appliance, and is configured for the required functionality by the configuration data supplied by the said Non-Volatile Memory,
- one set of inputs of the said Central Control Unit are connected to the outputs of an Input Interface Unit which receives the signals from various sensing elements in the appliance and conditions these signals using configurable hardware for further processing by the said Central Control Unit,
- one set of outputs of the said Central Control Unit are fed back to the said Input Interface Unit for controlling its internal operation,
- a second set of inputs of the said Central Control Unit receive user input data from the outputs of a User Interface Unit,
- a second set of outputs of the said Central Control Unit are fed back to the said User Interface Unit as signals for outputting data to the user by visual and audible means, as well as for controlling its internal operation,
- a third input of the said Central Control Unit is connected to one output of a Load Interface Unit to provide data on load conditions,

- a third set of outputs from ~~the~~ said Central Control Unit are connected to the inputs of the said Load Interface Unit ~~which drives~~ for driving the actuating means in the appliance for controlling its operation,
- a fourth input of ~~the~~ said Central Control Unit receives power supply condition signals from a Supply Interface Unit,
- ~~the~~ said Non-Volatile Memory Unit provides non-volatile storage of data and is connected to main circuit blocks consisting of ~~the~~ said Central Control Unit, Input Interface Unit, User Interface Unit, Load Interface Unit, and Supply Interface Unit,
- the outputs of a Clock Generator circuit ~~is~~ are connected to one input of each of ~~the~~ said main circuit blocks and ~~produces a~~ provides clock signals required for their operation,
- the output of a Reset circuit is connected to one input of each of ~~the~~ said main circuit blocks and produces a reset signal required for their proper initialization,
- ~~The~~ the arrangement between the components of the main circuit blocks is such that ~~the~~ said Central Control Unit receives sensed parameter data supplied by the various sensing devices in the appliance, from ~~the~~ said Input Interface Unit, user requirement data from ~~the~~ said User Interface Unit, load conditions data from the said Load Interface Unit, and the supply conditions data from ~~the~~ said Supply Interface Unit, and processes all this data in accordance with its configured functionality, and then applies signals to the inputs of ~~the~~ said Load Interface Unit for operating the actuating devices in the appliance for controlling its operation, and to the inputs of ~~the~~ said User Interface Unit for providing feedback to the user.

2. (currently amended) A Configurable Electronic Controller as claimed in claim 1,
wherein ~~the~~ said Central Control Unit ~~consists of~~ comprises:

- a Configurable Logic Circuit for implementing the basic control algorithms that determine the functioning of the appliance, which is configured in hardware for the required functionality by the configuration data supplied by ~~the~~ said Non-Volatile Memory
- one set of inputs of ~~the~~ said Configurable Logic Circuit are connected to the outputs of ~~the~~ said Input Interface Unit for receiving the signals from various sensing elements in the appliance,
- one set of outputs of ~~the~~ said Configurable Logic Circuit is connected to the input of ~~the~~ said Input Interface Unit for controlling its internal operation,
- a second set of inputs of ~~the~~ said Configurable Logic Circuit is connected to one output of ~~the~~ said User Interface Unit for receiving user supplied data,
- a second set of outputs of ~~the~~ said Configurable Logic Circuit is connected to the input of ~~the~~ said User Interface Unit for supplying feedback to the user as well as for controlling the internal operation of ~~the~~ said User Interface Unit,
- a third input of ~~the~~ said Configurable Logic Circuit is connected to one output of ~~the~~ said Load Interface Unit for receiving data about the load conditions,
- a third set of outputs of ~~the~~ said Configurable Logic Circuit is connected to one input of ~~the~~ said Load Interface Unit for controlling the load as well as for controlling the internal operation of ~~the~~ said Load Interface Unit,
- a fourth input of ~~the~~ said Configurable Logic Circuit is connected to one output of ~~the~~ said Supply Interface for receiving data on the supply conditions,
- a fifth input of ~~the~~ said Configurable Logic Circuit is connected to a Counters and timers block which contains an array of counters and timers required for the operation of the appliance,

- a sixth input of ~~the~~ said Configurable Logic Circuit is connected to a memory circuit for reading of data stored therein,
- a fourth output of ~~the~~ said Configurable Logic Circuit is connected to the said memory circuit for writing data into it,
- a seventh input of ~~the~~ said Configurable Logic Circuit is connected to the output of a Sequence Control circuit which provides the control signals required for defining the sequence of operations performed by ~~the~~ said Configurable Logic Circuit,
- an eighth input of ~~the~~ said Configurable Logic Circuit is connected to a Real-Time-Clock (RTC) circuit which provides time-of-day information required for the functioning of the Configurable Logic Circuit,
- a fifth output of ~~the~~ said Configurable Logic Circuit is connected to the input of ~~the~~ said RTC circuit for setting its value when required.
- the arrangement between ~~the~~ said Configurable Logic Circuit, Sequence Control circuit, Counters and Timers block, Memory block, and RTC circuit is such that the sensor data received from ~~the~~ said Input Interface Unit, user requirement data received from ~~the~~ said User Interface Unit, load conditions data supplied by ~~the~~ said Load Interface Unit, and supply conditions data furnished by ~~the~~ said Supply Interface Unit, are processed by ~~the~~ said Configurable Logic Circuit under the control of signals from ~~the~~ said Sequence Control circuit, using data supplied by the said Memory block, said Counters and Timers block and said RTC circuit, to generate the outputs required to control the loads through ~~the~~ said Load Interface Unit, provide feedback data required for the user through ~~the~~ said User Interface Unit, as well as supply signals required to update the data stored in ~~the~~ said Memory block, said Counters and Timers block and said RTC circuit, for use in subsequent processing.

3. (currently amended) A Configurable Electronic Controller as claimed in claim 1,
wherein ~~the~~ said Input Interface Unit ~~consists of~~ comprises:

- Sensor Drive circuits for providing bias signals to external sensing devices connected to the Electronic Appliance Controller,
- the output of each of ~~the~~ said Sensor Drive circuits is connected to the input of one channel of an Analog Multiplexer,
- the output of the said Analog Multiplexer is connected to the input of an Analog-to-Digital Converter,
- ~~the~~ said Analog-to-Digital Converter contains in-built circuitry for the correction for the sensitivity and offset of the signal from each sensing device,
- the output of ~~the~~ said Analog-to-Digital converter is connected to one input of a Digital Comparator,
- the other input of ~~the~~ said Digital Comparator is connected to ~~the~~ said Central Control Unit for receiving a reference signal,
- the output of ~~the~~ said Digital Comparator is connected to one input of a Digital Multiplexer,
- the other inputs of ~~the~~ said Digital Multiplexer receive digital signals from various sensing devices in the appliance,
- the output of ~~the~~ said Digital Multiplexer is connected to the input of a Noise Filter,
- the output of ~~the~~ said Noise Filter is connected to an input of ~~the~~ said Central Control Unit for furnishing data on the signals received from the various sensing devices,

- a Digital Demultiplexer receives input signals from ~~the~~ said Central Control unit and produces multiple digital output signals for scanning the status of various digital sensing devices in the appliance,
- the arrangement between ~~the~~ said Analog Multiplexer, said Analog-to-Digital Converter, said Digital Comparator, said Digital Multiplexer, and said Noise Filter is such that the sensor data received from analog sensors is selected by ~~the~~ said Analog Multiplexer Circuit under the control of signals from ~~the~~ said Central Control Unit, converted to digital form by ~~the~~ said Analog-to-Digital converter and applied to the inputs of ~~the~~ said Digital Multiplexer which also receives other digital signals directly from digital sensing devices in the appliance which are scanned by signals supplied by ~~the~~ said Digital Demultiplexer using signals supplied by ~~the~~ said Central Control Unit, and then applies these one-at-a-time under control of signals from ~~the~~ said Central Control Unit, to the input of the said Noise Filter for filtering and supplying to ~~the~~ said Central Control Unit for processing.

4. (currently amended) A Configurable Electronic Controller as claimed in claim 1, wherein ~~the~~ said User Interface Unit ~~consists of~~ comprises:

- Sensor Drive circuits for providing bias signals to various analog components, such as potentiometers, used for obtaining user selection values,
- the output of each of ~~the~~ said Sensor Drive circuits is connected to the input of one channel of an Analog Multiplexer,
- the output of ~~the~~ said Analog Multiplexer is connected to the input of an Analog-to-Digital Converter,
- ~~the~~ said Analog-to-Digital Converter contains circuitry for providing in-built correction for the sensitivity and offset of the signal from each sensing device,

- the output of ~~the~~ said Analog-to-Digital converter is connected to one input of a Digital Comparator,
- the other input of ~~the~~ said Digital Comparator is a reference signal received by the User Interface Unit from the Central Control Unit,
- the output of ~~the~~ said Digital Comparator is connected to one input of a Digital Multiplexer,
- the other inputs of ~~the~~ said Digital Multiplexer receive digital signals from various front-panel switches provided for receiving user input,
- the output of ~~the~~ said Digital Multiplexer is connected to the input of a Noise Filter,
- the output of ~~the~~ said Noise Filter is connected to an input of ~~the~~ said Central Control Unit,
- a Digital Demultiplexer receives input signals from ~~the~~ said Central Control unit and produces multiple digital output signals for scanning the status of the various digital inputs, such as switches, for obtaining user input,
- a second set of signals from ~~the~~ said Central Control Unit are connected to a set of Latches,
- the output of each of ~~the~~ said Latches is connected to the input of a Display and Audio Driver circuit which contains the circuitry for driving the display device and audio output device for providing output data to the user,
- the arrangement between ~~the~~ said Analog Multiplexer, said Analog-to-Digital Converter, said Digital Comparator, said Digital Multiplexer, said Noise Filter, said Digital Demultiplexer, and said Display and Audio Driver circuits is such that the sensor data received from the analog sensors in the User Interface is selected by ~~the~~ said Analog Multiplexer Circuit under the control of signals from ~~the~~ said Central Control Unit, converted to digital form by ~~the~~ said Analog-to-

Digital converter and applied to the inputs of ~~the~~ said Digital Multiplexer which also receives other digital signals received directly from digital sensing devices in the User Interface which are scanned by signals supplied by ~~the~~ said Digital Demultiplexer using signals from the Central Control Unit, and selectively applies them to ~~the~~ said Noise Filter under control of ~~the~~ said Central Control Unit, for filtering and supplying to ~~the~~ said Central Control Unit for processing, while simultaneously ~~the~~ said Display and Audio Driver circuit drives the external display and audio output devices in accordance with the data supplied by ~~the~~ said Central Control Unit.

5. (currently amended) A Configurable Electronic Controller as claimed in claim 1, wherein ~~the~~ said Load Interface Unit ~~consists of~~ comprises:

- a plurality of Latches for storing the data received from ~~the~~ said Central Control Unit,
- the output of each of ~~the~~ said Latches is connected to the input of a Switch Control circuit,
- the output of each of ~~the~~ said Switch Control circuits drives a Switch that operates a Load which is an actuating device in the appliance used to control its operation,
- one end of each of ~~the~~ said Switches is connected to the Load while the other end of the Switch is connected to a Current Sensor for sensing the current through the load,
- the output from each of ~~the~~ said Current Sensors is connected to one input of an Analog Multiplexer,
- the output of ~~the~~ said Analog Multiplexer is connected to the input of a Load Sense Circuit which incorporates in-built correction for the sensitivity and offset of the signal from each ~~Shunt~~ current sensor,

- the output of ~~the~~ said Load Sense Circuit is connected to one input of a Digital Comparator,
- the other input of ~~the~~ said Digital Comparator is a reference signal received by ~~the~~ said Load Interface Unit from the Central Control Unit,
- the output of ~~the~~ said Digital Comparator is connected to an input of ~~the~~ said Central Control Unit,
- the arrangement between ~~the~~ said Latches, said Switch Drive Circuits, said Switches, said Current Sensors, said Analog Multiplexer, said Load Current Sensing Circuit, said Digital Comparator and said output Latch, is such that the load current data received by ~~the~~ said Load Current Sensors is converted to digital form by ~~the~~ said Load Current Sense Circuit, compared with reference data supplied from ~~the~~ said Central Control Unit by ~~the~~ said Digital Comparator and supplied to ~~the~~ said Central Control Unit which furnishes signals for controlling the operation of ~~the~~ said Switch Drive Circuits through ~~the~~ said Latches.

6. (currently amended) A Configurable Electronic Controller as claimed in claim 1,
wherein ~~the~~ said Supply Interface Unit ~~consists of~~ comprises:

- a Supply Voltage Sense circuit which senses the voltage level of the input supply voltage,
- the output of ~~the~~ said Supply Voltage Sense circuit is connected to one input of each of two digital comparators,
- the second input of each of ~~the~~ said Digital Comparators is connected to a signal received from the said Central Control Unit,
- the outputs of ~~the~~ said Digital Comparators are connected to the input of a Latch,
- the output of ~~the~~ said Latch is connected to an input of ~~the~~ said Central Control Unit,

- the arrangement between ~~the~~ said Supply Voltage Sense circuit, said Digital Comparators, and said Latch is such that the sensed supply voltage is converted to digital form by ~~the~~ said Supply Voltage Sense circuit and compared by ~~the~~ said Digital Comparators with reference data supplied by ~~the~~ said Non-Volatile Memory, and the results of the comparison are latched by ~~the~~ said Latch and furnished to ~~the~~ said Central Control Unit as supply condition data.

7. (currently amended) A Configurable Electronic Controller as claimed in claim 1, wherein it further includes a Network Interface Unit that is connected to another output from ~~the~~ said Central Control Unit and provides an input to ~~the~~ said Central Control Unit for exchanging data between an external network and ~~the~~ said Central Control Unit.
8. (currently amended) A Configurable Electronic Controller as claimed in claim 2, wherein the said Configurable Logic Unit in one implementation is a Gate Array that is configured by the configuration data supplied by ~~the~~ said Non-Volatile Memory.
9. (currently amended) A Configurable Electronic Controller as claimed in claim 2, wherein the said Configurable Logic Unit in another implementation is an embedded microprogrammed controller that is configured by the configuration data supplied by ~~the~~ said Non-Volatile Memory.
10. (currently amended) A Configurable Electronic Controller as claimed in claim 2, wherein the said Configurable Logic Unit in another implementation is configurable in hardware for providing overcurrent protection and “Soft Start” facility that supplies a reduced voltage start to the load in order to minimize in-rush current stress at turn-on,

selectively to the loads through the signals applied to the inputs of the said Load Interface Unit.

11. (currently amended) A Configurable Electronic Controller as claimed in claim 2, wherein the said Configurable Logic Unit in another implementation is configurable in hardware for providing overheat protection selectively to the loads using temperature data supplied by sensing devices physically attached to the selected loads through the signals supplied by the said Input Interface Unit, and supplying applying signals to the inputs of the said Load Interface Unit to turn-off the drive to the loads in case of overheat conditions.

12. (currently amended) A Configurable Electronic Controller as claimed in claim 1, wherein the said Clock Generator is an oscillator with a frequency preferably in the range 32 KHz to 25 MHz.